What is claimed is:

[c1] 1. An engine or other device having a Z-crank operated by axially arranged pistons and cylinders whose axes parallel the rotational axis of the Z-crank and where the motion converter is prevented from rotating as it nutates by means of:
a) a reaction control shaft
b) the axis of rotation of which is parallel to the axis of rotation of the Z-crank
c) the reaction control shaft, having a cylindrical section parallel to and offset from its axis of rotation
d) so as to provide an eccentric bearing surface
e) for a bushing mounted to the motion converter
f) that rotates relative to the motion converter and slides and rotates relative to the reaction control shaft
g) where the reaction control shaft is driven by gears or other means to rotate at twice the Z-crank speed.

[c2] 2. An engine or other device as described in Claim 1 where there are two complete sets of motion converters, connecting rods and pistons combined face-to-face and there is a double Z-crank.

[c3] 3. An engine or other device as described in Claim 1 where there are two complete sets of motion converters, connecting rods and pistons combined back-to-back and there is a double Z-crank.

[c4] 4. An engine or other device having a Z-crank operated by axially arranged pistons and cylinders whose axes parallel the rotational axis of the Z-crank and where the motion converter is prevented from rotating as it nutates by means of:
a) a stationary gear coaxial to the axis of rotation of the Z-crank and fixed to the engine housing

b) engaged with a planetary gear carried on the Z-crank

c) the planetary gear and a third gear fixed together

d) the third gear engaged with a fourth gear that is fixed to the motion converter

e) the ratio between the planetary gear and the stationary gear is the same as the ratio between the third gear and the fourth gear.

[c5] 5. An engine or other device as described in Claim 4 where there are two complete sets of motion converters, connecting rods and pistons combined face-to-face and there is a double Z-crank.

[c6] 6. An engine or other device as described in Claim 4 where there are two complete sets of motion converters, connecting rods and pistons combined back-to-back and there is a double Z-crank.

[c7] 7. An engine or other device having a Z-crank operated by axially arranged pistons and cylinders whose axes parallel the rotational axis of the Z-crank and where the Z-crank is provided with splines or other means at both ends to allow for axial movement of the Z-crank relative to its output connection and flywheel and its valve gear and accessory drive.

[c8] 8. An engine or other device as described in Claim 7 where there are two complete sets of motion converters, connecting rods and pistons combined face-to-face and there is a double Z-crank.

[c9] 9. An engine or other device as described in Claim 7 where there are two complete sets of motion converters, connecting rods and pistons combined back-to-back and there is a double Z-crank.

[c10] 10. An engine or other device having a Z-crank operated by axially arranged pistons and cylinders whose axes parallel the rotational axis of the Z-crank and

where the compression ratio of the device is automatically varied during operation by means of:

a) a mechanical actuator

b) electronically controlled by an engine control unit

c) that displaces the Z-crank and motion converter along its axis

d) in response to variations in power demand, load and other conditions

e) as input to the engine control unit from sensors.

[c11] 11. An engine or other device as described in Claim 10 where there are two complete sets of motion converters, connecting rods and pistons combined face-to-face and there is a double Z-crank.

[c12] 12. An engine or other device as described in Claim 10 where there are two complete sets of motion converters, connecting rods and pistons combined back-to-back and there is a double Z-crank.

[c13] 13. An engine or other device having a Z-crank operated by axially arranged pistons and cylinders whose axes parallel the rotational axis of the Z-crank and where the connecting rods are provided at one or both ends with split shell bearings having:

a) a spherical surface on the inner surface of the bearing

b) a cylindrical surface on the outer surface of the bearing

c) a means for locating and fixing the bearing to the connecting rod

d) auxiliary cylindrical bearing surfaces to engage trunnion pins

and concentrically supporting a trunnion having:

a) a spherical outer surface

b) a cylindrical inner surface for interface to a wrist pin

c) cylindrical trunnion pins to prevent rotation of the connecting rod about its long axis.

[c14] 14. An engine or other device having a Z-crank operated by axially arranged pistons and cylinders whose axes parallel the rotational axis of the Z-crank where:

a) the piston and associated connecting rod are fixed together

b) the outside of the piston is tapered at one or both ends

c) the largest diameter section of the piston is spherical in shape and is slightly smaller in diameter than the cylinder into which it is fitted.

[c15] 15. An engine or other device having a Z-crank operated by axially arranged pistons and cylinders whose axes parallel the rotational axis of the Z-crank where:

a) the piston and associated connecting rod are combined into a single piece

b) the outside of the piston is tapered at one or both ends

c) the largest diameter section of the piston is spherical in shape and is slightly smaller in diameter than the cylinder into which it is fitted.